Claims

What is claimed:

1. A process for the production of a vinyl aromatic compound by the catalytic dehydrogenation of a C_2 or C_3 alkyl aromatic compound:

a. supplying a feedstock containing a C_2 or C_3 alkyl aromatic compound and steam into a tubular reactor having a mixing section comprising a longitudinally-extending helical baffle inside the tubular reactor provide a spiral flow path for the mixing of said alkyl aromatic compound and steam;

b. heating said tubular reactor by applying heat externally of said tubular reactor to provide an amount of heat which varies along the length of the tubular reactor;

c. supply said mixed steam and alkyl aromatic compound into contact with a particulate dehydrogenation catalyst in said tubular reactor under temperature conditions effective to cause the dehydrogenation of said alkyl aromatic compound to a corresponding vinyl aromatic compound in the presence of said dehydrogenation catalyst; and

d. recovering said vinyl aromatic product from said reactor through an outlet downstream of said dehydrogenation catalyst.

2. The process of claim 1 wherein said mixing section incorporates a second helical baffle having a pitch different from the pitch of said first recited helical baffle.

3. The process of claim 1 wherein said feedstock is passed along said spiral flow path at a location adjacent the inlet side of said reactor.

4. The process of claim 1 wherein at least a portion of said spiral flow path contains a particulate dehydrogenation catalyst.

5. The process of claim 1 wherein said helical baffle extends throughout a major portion of the length of the elongated tubular reactor to provide said spiral flow path and at least a portion of said spiral flow path contains a particulate dehydrogenation catalyst.

6. The process of claim 1 wherein said feedstock comprises ethyl naphthalene and the vinyl aromatic compound comprises vinyl naphthalene.

7. The process of claim 1 wherein said feedstock comprises n-propyl benzene and said vinyl aromatic compound comprises beta methylstyrene.

8. The process of claim 1 wherein said feedstock comprises cumene and said vinyl aromatic compound comprises alpha methylstyrene.

9. The process of claim 1 wherein said feedstock comprises ethyl toluene and said vinyl aromatic product comprises vinyl toluene.

10. The process of claim 1 wherein said feedstock comprises diethylbenzene and said product comprises divinyl benzene.

11. The process of claim 10 wherein said feedstock comprises a mixture of meta diethylbenzene and para diethylbenzene wherein the weight ratio of the para isomer to the meta isomer is within the range of 3:2-2:3.

12. The process of claim 11 wherein the steam to diethylbenzene mole ratio of said feedstock is about 16 or less.

13. The process of claim 11 wherein the steam to diethylbenzene mole ratio of said feedstock is within the range of 8-13.

14. The process of claim 12 wherein said feedstock is free of ortho diethylbenzene or contains ortho diethylbenzene in an amount of no more than 5 mole percent.

15. A process for the production of a vinyl aromatic compound by the catalytic dehydrogenation of a C_2 or C_3 alkyl aromatic compound comprising:

a. supply a feedstock containing a C_2 or C_3 alkyl aromatic compound and steam into a plurality of tubular reactors located within the interior of a dehydrogenation reactor vessel and arranged in a parallel relationship with respect to one another in which the tubular reactors are spaced from one another and spaced from the interior wall of the reaction vessel, each of said tubular reactors having a mixing stage comprising a longitudinally-extending helical baffle inside each of said tubular reactors, providing a spiral flow path for the mixing of said alkyl aromatic compound and steam;

b. heating the interior of said reaction vessel to provide heat externally of said tubular reactor to provide an amount of heat which varies along the lengths of the tubular reactors;

c. within said tubular reactors, supplying said mixed steam and said alkyl aromatic compound into contact with a particular dehydrogenation catalyst in said tubular reactors under temperature conditions resulting from the externally applied heat, effective to cause the dehydrogenation of said alkyl aromatic compound to a corresponding vinyl aromatic compound in the presence of said dehydrogenation catalyst; and

d. recovering said vinyl aromatic product from said tubular reactors through outlets of said tubular reactors.

16. The process of claim 15 wherein the mixing stages of said tubular reactors providing said spiral flow paths are located at least adjacent the inlets of said tubular reactor.

17. The process of claim 15 wherein the spiral flow paths of said reactors extend throughout major portions of the lengths of the elongated tubular reactors and at least a portion of said spiral flow paths contain a particulate dehydrogenation catalyst.

18. The process of claim 15 wherein said feedstock comprises diethylbenzene and the vinyl aromatic product comprises divinyl benzene.

19. The process of claim 18 wherein said feedstock comprises a mixture of meta diethylbenzene and para diethylbenzene in a mole ratio of the para isomer to the meta isomer within the range of 3:2-2:3.

20. A process for the production of divinyl benzene by the catalytic dehydrogenation of diethylbenzene comprising:

a. supplying a feedstock containing diethylbenzene and steam into a tubular reactor containing a dehydrogenation catalyst;

b. operating said tubular reactor under temperature conditions effective to cause the dehydrogenation of diethylbenzene to divinyl benzene in the presence of said dehydrogenation catalyst;

c. flowing said feedstock within at least a portion of said reactor along a spiral flow path located within and extending longitudinally of said reactor; and

d. recovering divinyl benzene product from a downstream section of said reactor.

21. The process of claim 20 wherein said diethylbenzene feedstock is free of ortho diethylbenzene or exhibits a maximum ortho diethylbenzene content of no more than 10%.

22. The process of claim 21 wherein said maximum ortho diethylbenzene content is no more than 5 wt.%.

23. The process of claim 20 wherein said diethylbenzene feedstock contains a predominant amount of meta diethylbenzene.

24. The process of claim 20 wherein said feedstock comprises a mixture of meta diethylbenzene and para diethylbenzene wherein the mole ratio of the para isomer to the meta isomer is within the range of 3:2-2:3.

25. The process of claim 24 wherein said diethylbenzene content contains para diethylbenzene and meta diethylbenzene in a mole ratio of about 3:2.

26. In a reaction system for the catalytic reaction of a plurality of reactants in a feed stream, the combination comprising:

a. a plurality of parallel-arranged, elongated, tubular reactors having inlet side and outlet sides;

b. an inlet manifold connected to said tubular reactors for supplying a mixture of reactants to the inlet sides of said reactors;

c. a mixing section in each of said reactors adjacent the inlet side thereof and comprising at least one static baffle in an elongated helical configuration comprising a spiral flow path;

d. a reaction section in said each of said reactors located downstream of said mixing section and comprising a bed of catalyst particles; and

e. an outlet manifold connected to the outlet sides of said tubular reactors;

f. a recovery system for recovering a reaction product from said tubular reactor.

27. The system of claim 26 wherein said reaction section comprises an elongated baffle of a helical conformation extending through at least a portion of said catalyst bed.